

A DEVICE AND METHOD FOR NEUTRALIZING CHEMICAL AGENTS

STATEMENT OF GOVERNMENT INTEREST

The invention described herein may be manufactured, used and licensed by or for the United States Government.

FIELD OF THE INVENTION

The present invention is directed to containment, neutralization and disposal of chemical contaminants present in Chemical Agent Identification Sets (CAIS). The system of the present invention allows for rapid monitoring and treatment of CAIS without the need for large-scale neutralization apparatus.

BACKGROUND OF THE INVENTION

Over 160,000 chemical agent identification sets (CAIS) were produced between 1928 and 1969. These sets were used to train soldiers to identify chemical warfare agents in the field. Current law allows CAIS to be held without treatment at specific sites in the United States. However, state policies and public concern often preclude such storage.

A rapid response system (RRS) has been developed and used to receive, contain, characterize, monitor and treat recovered CAIS from burial sites. The purpose of the RRS was to provide safe and effective containment and disposal of the CAIS. The RRS included two trailers and a mobile analytical support platform (MASP) for analyzing the waste and treatment residues on the CAIS sites. The MASP also provided air quality management monitoring devices, alarms, impingers and protocol for recording contaminants in the air. Additional trailers have

been used for support equipment and administrative offices. Once treated with the appropriate decontaminants, remaining neutralized materials are transported to a commercial waste treatment facility for ultimate disposal.

While the RRS system is beneficial for large CAIS recovery sites it has been cost prohibitive for smaller CAIS quantity sites. In addition, there is also a need to address emergency situations where quick reduction of agent contamination/hazard is imminently necessary to protect the public. Therefore, there is a need to rapidly reduce chemical warfare agent hazard associated with CAIS at smaller recovery sites and in emergency situations that is provided for by the present invention as described below.

SUMMARY OF THE INVENTION

It is therefore an object of the present invention to provide a Chemical-agent Access and Neutralization System (CANS) container that is capable of rapidly accessing and neutralizing chemical contaminants without harming the environment.

It is another object of the present invention to provide a Chemical-agent Access and Neutralization System that is economical and provides an efficient manner of neutralizing chemical contaminants.

It is yet another object of the present invention to provide a unique break system that allows chemical contaminants and neutralizing agents stored within a closed container to be intermixed without harm to the environment.

It is yet another object of the present invention to provide a container having a flanged lid that is hermetically sealed when in use, and capable of easy removal for placement/removal of contaminants and reagents within the container.

It is yet another object of the present invention to provide a torque mechanism for fastening the flanged lid to the body of the container to facilitate a proper seal between the container and the environment.

It is yet another object of the present invention to provide a container that allows
5 admixing of the chemicals by placement of the container in different positions.

It is yet another objective of the present invention to monitor reaction conditions within the container without contaminant leakage to the environment.

These and other objectives are described below.

BRIEF DESCRIPTION OF THE DRAWINGS

FIGURE 1 shows the Chemical-agent Access and Neutralization System (CANS) container in an open position.

FIGURE 1a shows the interior of the Chemical-agent Access and Neutralization System
15 (CANS) container.

FIGURE 1b shows an alternate embodiment of the cradle.

FIGURE 1c shows the Chemical-agent Access and Neutralization System (CANS) container in a closed configuration.

FIGURE 2 shows the break mechanism and sample port of the present invention.

FIGURE 2a shows an exemplary torque mechanism of the present invention.

FIGURE 2b shows the vertical position of the container of the present invention.

FIGURE 2c shows the horizontal position of the container of the present invention.

DETAILED DESCRIPTION OF THE EMBODIMENTS

1. System Description:

As shown in **Figure 1**, the Chemical-agent Access and Neutralization System (CANS) of the present invention includes a container **1** that provides containment for neutralization

5 treatments of chemical contaminants. Container **1** is preferably constructed of inert plastics, however other materials suitable for containment and neutralization of contaminants are also within the scope of the present invention. Kynar® is a preferred thermoplastic material for container **1** because it is also translucent allowing visual confirmation when internal reagents are released. A preferred method of making container **1** is via injection molding. **Figure 1** shows

10 the container **1** in an open position. In a preferred embodiment, container **1** has a flanged lid portion **2** and a body portion **3**. The flanged lid portion **2** is configured with a plurality of apertures **2a** positioned circumferentially around the outer edge of flanged lid portion **2**. Lid portion **2** also includes a handle **2b** to allow container **1** to be moved, as will be discussed below.

Lid portion **2** also includes at least one sample valve **2c** through which a sample probe can be

15 inserted so that reaction conditions within container **1** can be measured and/or monitored.

Exemplary sample probes include pressure transducers. Sample valve **2c** maintains an air tight/contaminant impermeable seal both in its closed position and when a sample probe is inserted into container **1** through sample valve **2c**. The body portion **3** includes a plurality of

apertures **3a** positioned circumferentially around the outer edge of a flange section **3b**. The

20 plurality of apertures **2a** align with apertures **3a** when lid portion **2** is placed upon body portion

3. In a preferred embodiment, this arrangement of apertures is threaded to permit flanged lid **2** to be hermetically sealed against body portion **3** using bolts. The flanged section **3b** of body portion **3** also includes a groove **3c** fitted with an o-ring **3d**. The o-ring **3d** further provides for an

air-tight/contaminant impermeable seal when container **1** is closed. Of course, the use of threaded bolts with corresponding apertures **2a** and **3a** is only one preferred method of sealing the lid **2** to the body **3**. Other methods of sealing containers are well known to those of skill in the art and it is not intended to limit the invention to the preferred embodiment described here.

5 For example, clamps similar to those used to seal drums or a Grayloc® seal design with clamp can be used to provide an even pressure around the circumference of the lid in lieu of bolts.

Alternative sealing materials such as Teflon® and metal gaskets have also been found suitable.

Moreover, alternative designs to a flat lid can also be used; for example, dome-shaped lids can be used to optimize strength. The body portion **3** includes upper and lower rims **3e** and **3f**, which

10 are configured to perform as stabilizing legs as will be discussed below.

As shown in **Figure 1a**, body portion **3** forms an interior chamber **3g** that houses a holder **4**. The holder **4** is also preferably made of inert plastics. Holder **4** includes first and second cradles **4a** and **4b**. Holder **4** also includes openings **4c** to allow easy removal of holder **4** from body portion **3**. Cradle **4a** holds a chemical agent containing CAIS container **5**, while cradle **4b**
15 securely holds a chemical reagent container **6** which contains reagents useful for treating and/or neutralizing chemical agents contained in the CAIS **5**. CAIS container **5** can be in the shape of bottles or ampoules. Reagent container **6** holds a quantity of treatment reagent sufficient to neutralize the identified CAIS agents in container **1**.

As shown in **Figure 1b** if container **5** is in the shape of an ampoule, a third securing
20 cradle **4d** is utilized to hold the ampoule in place.

Alternative cradle designs were evaluated which allowed three to five ampoules to be treated at the same time. The current standard quantity of reagent was found sufficient to treat this larger quantity of ampoules.

In a closed position, as shown in **Figure 1c**, a plurality of bolts **B** are positioned through apertures **2a** and **3a** (not shown) to secure lid portion **2** to body portion **3** and provide an air tight/contaminant impermeable seal between the container **1** and the environment.

The exterior surface of body portion **3**, as shown in **Figure 2**, includes an opening **3h** that is connected to a break system **BS**. The break system **BS** includes a screw bolt **7** having a top section **7a**, a screw portion **7b** and a notched section **7c** connected to flexible seal **7d**. The break system **BS** also includes a closing mechanism **8** that is connected to the screw bolt **7**. The closing mechanism **8** includes a cap **8a** that is connected to the closing mechanism **8** through a chain **8b**.

The cap **8a** is internally threaded so as to mate with screw bolt **7** and engage flexible seal **7d**.

Attaching cap **8a** to the closing mechanism **8** allows for cap **8** to be quickly fitted over screw bolt **7**. Additionally, the break system **BS** includes a solid metal break rod **9** having a flat top end **9a** and a pointed bottom end **9b**. The break rod **9** is configured so that bottom end **9b** is inserted into the container **1** through opening **3h** when notched section **7c** is pierced. Once break rod **9** is inserted through the screw bolt **7**, the closing mechanism **8** forms an air-tight/contaminant

impermeable seal between the container **1** and the environment. Also as shown in **Figure 2**, the body portion **3** houses at least one sample valve **10**. A sample probe (not shown) is inserted into sample valve **10** so that reaction conditions inside container **1** can be monitored. The sample valve **10** is configured to form an air tight/contaminant impermeable seal in its closed position and also when sample probes are inserted. Exemplary sample probes include thermocouples.

2. Method of use:

In use, bolts **B** are removed and the flanged lid portion **2** is lifted, making sure that o-ring **3d** is not dislodged from groove **3c**. The lid portion **2** is removed using handle portion **2b**.

Thereafter, break rod **9** is placed so that it is fully extended out of container **1**. To facilitate this

position, break rod **9** is grasped and pulled from the chamber **3g**. Using openings **4c**, holder **4** is removed so that the CAIS container **5** and the reagent container **6** can be positioned in chamber **3g** of container **1**. Holder **4** is then inserted into chamber **3g** so that the CAIS container **5** is held within first cradle **4a** and the reagent container **6** is held within second cradle **4b** (for ampoules, the third cradle **4d** is also utilized). Thereafter, lid portion **2** is repositioned over bottom portion **3** making sure that o-ring **3d** is correctly positioned in groove **3c**. Bolts **B** are fastened to provide proper torque to seal lid portion **2** to body portion **3** over container **1**. Emphasis is placed upon proper torque to maintain an airtight seal and optimum reaction conditions during the neutralization process. **Figure 2a** shows an exemplary fastening pattern for an 8-bolt system, where the bolts **B_a** through **B_h** are sequentially torqued beginning with bolt **B_a** and ending with bolt **B_h**.

Thereafter, container **1** is moved using handle **2b**, from a vertical position as shown in **Figure 2b** to a horizontal position as shown in **Figure 2c**, where upper and lower rims **3e** and **3f** become stabilizing legs. Sample probes are attached at valves **2c** and **10** so that reaction conditions can be monitored. The break rod **9** is then driven down into the container **1** such that bottom portion **9b** pierces through CAIS container **5** and reagent container **6**, held within holder **4**. Thereafter, cap **8a** is fastened, to prevent contaminants or reaction fluids from escaping the container **1**. Container **1** is then again shifted to the vertical position as shown in **Figure 2b** to allow the chemicals from containers **5** and **6** to mix for a desired reaction time. Once reaction is complete, container **1** can be placed within a Department of Transportation (DOT) certified shipping container, and shipped to permitted hazardous waste management facilities for ultimate disposal. The unit is designed to be disposable and as a safety feature is specifically designed to weaken and leak before it explodes in an incinerator.

A variety of treatment agents can be used depending upon the chemical agent stored in container 5. Table 1, below, provides a preferred list of chemical reagents that are useful. It is understood that the listed neutralizing reagents are exemplary and any reagents capable of working within the confines of the CANS system are also within the scope of this invention.

3. Reagents utilized:

The following is a list of alternative treatment reagents found to be useful in the present CANS system:

Table 1

Monoethanolamine (MEA)
20% Sodium persulfate (SPS), aqueous.
20% Magnesium monoperoxyperphthalate (MMPP), aqueous.
14% Sodium percarbonate (SPC), aqueous.
15% Hydrogen peroxide (HP), aqueous.
10% Calcium hypochlorite (High Test Hypochlorite (HTH), aqueous.

Table 2 provides concentration data for neutralizing mustard and Lewisite chemical warfare agents using the reagent 1,3-Dichloro-5, 5-dimethylhydantoin (DCDMH).

Table 2

Process	Use	Reagents
Red	Nitrogen Mustard (HN-1 only) Sulfur mustard (H/HD) Lewisite (L) in chloroform solution	DCDMH 0.555 molar in a mixture of chloroform (45%), t-butyl alcohol (48.5%), water (3%)
Blue	Sulfur Mustard (H/HD)	DCDMH 0.555 molar in a mixture of chloroform (48.5%), t-butyl alcohol (48.5%), water (3%)
Charcoal	Nitrogen Mustard or Sulfur Mustard absorbed on charcoal	DCDMH in chloroform (0.91M)
Charcoal-L	Lewisite absorbed on charcoal	DCDMH 0.555 molar in a mixture of chloroform (48.5%), t-butyl alcohol (48.5%), water (3%)

Of course, concentrations of reagents can be modified significantly and remain effective for neutralizing the toxic chemical agents.

While the present invention has been particularly shown and described with reference to preferred embodiments, it will be readily appreciated by those of ordinary skill in the art that various changes and modifications may be made without departing from the spirit and scope of the invention. It is intended that the claims be interpreted to cover the disclosed embodiments, those alternatives which have been discussed above, and all equivalents thereto.